

1998

Acoustic Analysis of Body Condition in the Northern Right Whale

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Grant # N00014-98-1-0849

19990805 059

ONR Program Officer: Robert Gisiner

Long-term Research objective:

Northern right whales are known to be undergoing chronic reproductive failure, when compared to Southern right whales. Possible contributing stressors include inbreeding, chemical exposure, infectious disease, man-made noise and inadequate nutrition. We have so far developed evidence of possible increased chemical exposure in feeding northern right whales. The ONR-funded portion of our program focuses on body-fat condition as an index of health.

S&T objective:

The current ONR funded portion of this long term program tests if body condition as measured by blubber thickness is predictive of reproductive success. To do this, available acoustic technology had to be adapted and improved to measure blubber thickness in live free-ranging right whales.

Approach:

We have developed, and continue to refine the use of analog-mode ultrasound to measure blubber thickness while a right whale surfaces for air. The acoustic blubber-depth echoes so obtained are normalized for sampling position upon the animal, and for animal size. These data are then compared with known catalogued reproductive history for each animal so measured.

S&T completed:

In August 1998 we deployed for the first time a Panametrics Inc. Epoch 3 ultrasound system, with custom software for PC data capture. We used a 500 kHz transducer mounted on an articulated, counterbalanced carbon fibre pole that allowed placement of the probe on the back of the animal as it surfaced. Concurrent video images were obtained for body length estimation and recording of probe placement. These data were obtained on 92 animals in 6 days on the water. A significant limitation was data acquisition rate through the PC serial port (2 Hz). Many animals encountered in 1998 were sub adult, thus the available sample size for potentially reproductive females is currently small, but trends to date suggest that blubber thickness appears to increase with time after calving. Blubber also appears to increase in thickness with age in females, but not males. Data analysis for 1998 is ongoing. On April 21 1999 we obtained a comprehensive series of physical and acoustic measures of dorsal blubber thickness from right whale #1014, during necropsy subsequent to a fatal ship collision. These and other data are being built into a numerical model to better normalize our field measures in terms of sampling position. In the past month we have retooled our ultrasound system to allow 20 images a second to be recorded, by acquiring a Panametrics 9100 digital system, with GPIB porting to a PC with the necessary custom software developed by UpperCape Systems Inc.

Impact/Navy Relevance:

This is the first time that body condition has been measured in any live cetacean unrestrained. Our preliminary data suggest that measures of body condition will be useful in predicting the next calving interval, thus giving a predictive tool for monitoring right whale populations. The mechanical pole system we have developed is proving to be useful for the rapid deployment of

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suction cup tag systems on to the backs of large whales with minimal disturbance to the animal. In the Bay of Fundy we will deploy tags on right whales for the WHOI Tyack laboratory in July and August of this year whilst measuring blubber thickness concurrently. Our hardware and software configuration may also have utility to other projects that require high data rate acquisition of acoustic echoes of any solid or liquid - animal, water or sediment.

Planned Research Efforts:

Our final field work for this phase of the project will occur in July through September of this year, deploying our improved system in the Bay of Fundy and off Cape Town South Africa to obtain reference data from Southern right whales. This system will include a new video camera mount that will allow downward images of the surfacing animal to get good girth and length measures. This involves another carbon fibre pole system rigged to the vessel. The fall and winter of 1999 should see data analysis and reporting using support from the Massachusetts Environmental Trust, which has also supported this work over a three year period. A no-cost extension to complete the ONR funded phase would be much appreciated.

References:

- Moore, M. J., C. A. Miller, M. S. Morss, R. Arthur, W. Lange and S. Kraus (1997). "Cruise No. 97-081: Health Assessment of the Northern Right Whale. Cruise Report to: Rinehart Coastal Research Center, Woods Hole Oceanographic Institution, Massachusetts Environmental Trust and US State Department." : 1-10.
- Moore, M. J., C. A. Miller, M. S. Morss, R. Arthur, W. Lange, K. G. Prada, M. K. Marx, and E. A. Frey. In Press. Ultrasonic measurement of blubber thickness in right whales. J. Cetacean Research and Management.
- Miller, C.A., Morss, M., Marx, M., Moore, M. Acoustic Measurements of blubber thickness versus age, sex and reproductive history in northern right whales. Abstract Submitted to Marine Mammal meeting in Maui, Nov. 1999

Other Sponsored Science and Technology:

Molecular Biological Approaches for Non-Destructive Assessment of Chemical Effects on Marine Animals. NOAA, SG NA46RG0470. \$316,202 9/1/95-2/29/00. This project develops and utilizes a series molecular tools to assess the impact of man made contaminants on marine mammals. The project has demonstrated systemic impacts of dioxin-like chemicals in a diversity of cetacean and pinniped species.

Biochemical Toxicology in Cetaceans. NOAA, SG NA86RG0075 \$61,778 3/1/98-2/29/00. An archived series of tissue samples from necropsied marine mammals is being subjected to a battery of toxicological tests by ourselves and a series of collaborators.

MWRA HOM III Sub-contract Bid for Flounder Studies and Related Tasks - Battelle Ocean Sciences \$176,859 11/19/97-6/30/01. Since 1986 Dr Moore has monitored the annual change in prevalence of contaminant induced liver disease in winter flounder. This project forms a key aspect of the Boston Harbor Outfall Monitoring project.

Program Management and Veterinary Services for the Cape Cod Stranding Network. \$77,952 3/1/99-2/28/02. This project manages the daily case load of live and dead marine mammals on the beaches of Cape Cod, in conjunction with the New England Aquarium.

Cytochrome P4501A Expression, Histopathology and Chemical Contaminants in Roach and Goby from the Caspian Sea & Ily River Delta, Kazakhstan. Texaco, Inc. \$29,614. 7/29/98-1/31/00. In collaboration with colleagues from Kazakhstan, this project assesses chemical impacts in fish in the NE Caspian Sea, exposed to agricultural and petroleum derived chemicals.

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ONR Program Officer: Robert Gisiner

Subcontractors: None

Productivity:

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Technology Transfer:

This project involves the adaptation of the 9100 digital ultrasound system from Panametrics Inc., Waltham MA, (www.panametrics.com). The software developed for our project by Upper Cape Systems Inc. (www.uppercape.com), Falmouth MA, marks the first time this commercially available ultrasound unit has been set up for high speed field data acquisition via a GPIB port to a PC. The principal of Upper Cape Systems, Ken Prada, a retired WHOI engineer, has been involved in discussions with ourselves, and the Panametrics software engineers about the potential of expanding the software code developed for our project to a fully supported application that would form part of the Panametrics product line. Thus the potential for technology transfer in the near future is quite high.

Presentations:

The Marine Mammal Health Jigsaw - by Michael Moore at the Woods Hole Oceanographic Institution, Associates Day of Science. September 25 1998.

Blubber Thickness in Right Whales - by Carolyn Miller (Graduate Student on Project) - at the Fall Right Whale Consortium Meeting, New England Aquarium, Boston MA October 20th, 1998.

Contaminants and Blubber Thickness in Northern Right Whales. - by Michael Moore. US Marine Mammal Commission Meeting, Portland ME, November 10th 1998.

Blubber Thickness in Right Whales - by Carolyn Miller at the North East Regional Student Chapter of the Society for Marine Mammalogy, Woods Hole, MA, February 19, 1998.

Number of Students Supported:

One - Carolyn Miller. Doctoral Candidate Boston University Marine Program.

Females: One

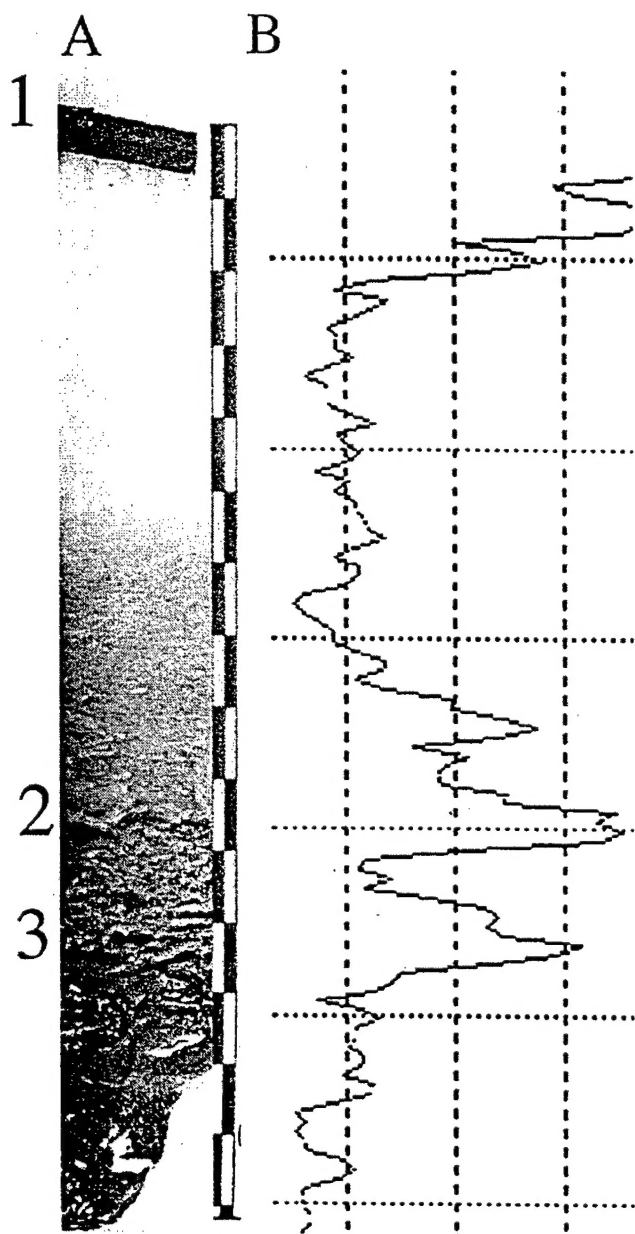
Description for image in 335moore1.jpg

A surfacing right whale being gently touched by a non-invasive ultrasound probe. The vessel is behind and to the side of the surfacing whale. The image shows the pole end with the transducer laying on the back of the whale just after the blowholes have submerged at right.



Description for image in 335moore2.jpg

Photograph of a slice of blubber and muscle from a northern right whale, catalog No. 2220, which was necropsied at Wellfleet MA, March 9 1996. 1. Epidermis. 2. Superficial sub-dermal connective tissue sheath. 3. Deep sub-dermal connective tissue sheath. B: 0.5 MHz echograph of the same sample. Strong signal strength is evident at both 2 and 3. Centimeter scale in center.



Description for image in 335moore3.jpg

Dorsal blubber sheet removal during the necropsy of Northern right whale #1014. April 21 1999, Duck Harbor Beach, Wellfleet, MA. Prior to dissection the entire dorsal surface was scanned acoustically to obtain a baseline for normalization of data from free swimming live animals.



REPORT DOCUMENTATION PAGE			Form Approved OMB No. 0704-0188
Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding the burden estimate or any other aspect of the collection of information, including suggestions for reducing the burden, to Washington Headquarters Services, Directorate for Information Operations & Reports 12 15 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, & to the Office of Management & Budget Paperwork Reduction Project, Washington, DC 20503.			
1. Agency Use Only	2. Report Date Progress: 8/15/98-June 99	3. Report Type and Dates Covered Performance Report - Annual	
4. Title and Subtitle: Acoustic Analysis of Body Condition in the Northern Right Whale			5. Funding Numbers N00014-98-1-0849
6. Author(s) Michael Moore			
7. Performing Organization Name(s) and Address(es) Woods Hole Oceanographic Institution			8. Performing Organization Report Number WHOI Proposal No. 2537
9. Sponsoring/Monitoring Agency Name(s) and Address(es) ONR Ballston Centre Tower One 800 N. Quincy Street Arlington, VA 22217-5660			10. Sponsoring/Monitoring Agency Report Number
11. Supplementary Notes			
12a. Distribution/Availability Statement Approved for public release; distribution is unlimited			12b. Distribution Code
13. Abstract Northern right whales are known to be undergoing chronic reproductive failure, when compared to Southern right whales. Possible contributing stressors include inbreeding, chemical exposure, infectious disease, man-made noise and inadequate nutrition. We have so far developed evidence of possible increased chemical exposure in feeding northern right whales. The ONR-funded portion of our program focuses on body-fat as an index of health. The current ONR funded portion of this long term program tests if body condition as measured by blubber thickness is predictive of reproductive success. To do this, available acoustic technology had to be adapted and improved to measure blubber thickness in live free-ranging right whales. We have developed, and continue to refine the use of analog-mode ultrasound to measure blubber thickness while a right whale surfaces for air. The acoustic blubber-depth echoes so obtained are normalized for sampling position upon the animal, and for animal size. These data are then compared with known catalogued reproductive history for each animal so measured. Data collection is scheduled for the Bay of Fundy and off Cape Town, South Africa: July - Sept 1999.			
14. Subject Terms			15. Number of Pages
			16. Price Code
17. Security Classification of Report	18. Security Classification of this Page	19. Security Classification of Abstract	20. Limitation of Abstract

NSN 7540-01-280-5500

Standard Form 298 (Rev. 2-89)